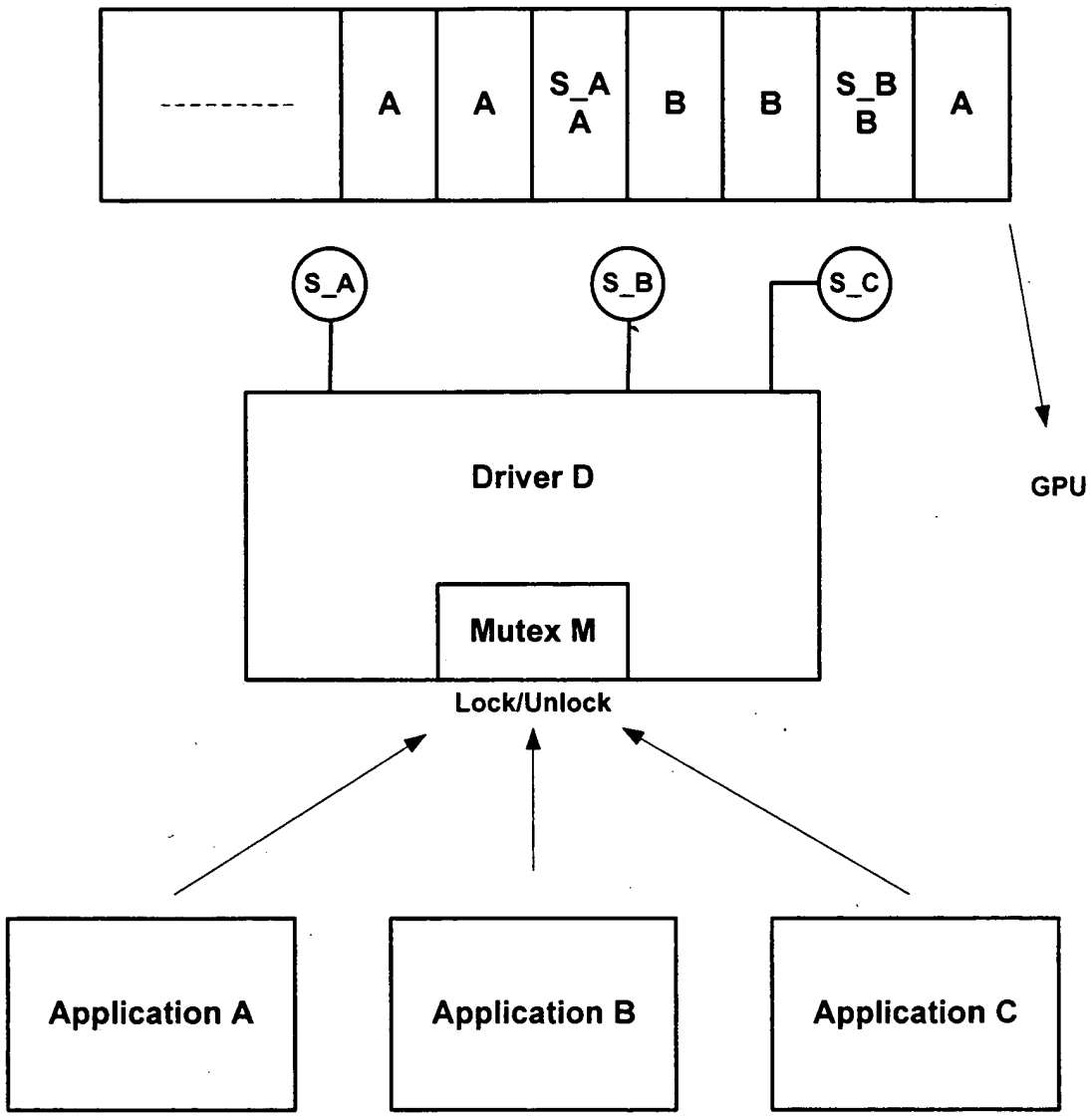


FIG. 1 – Prior Art

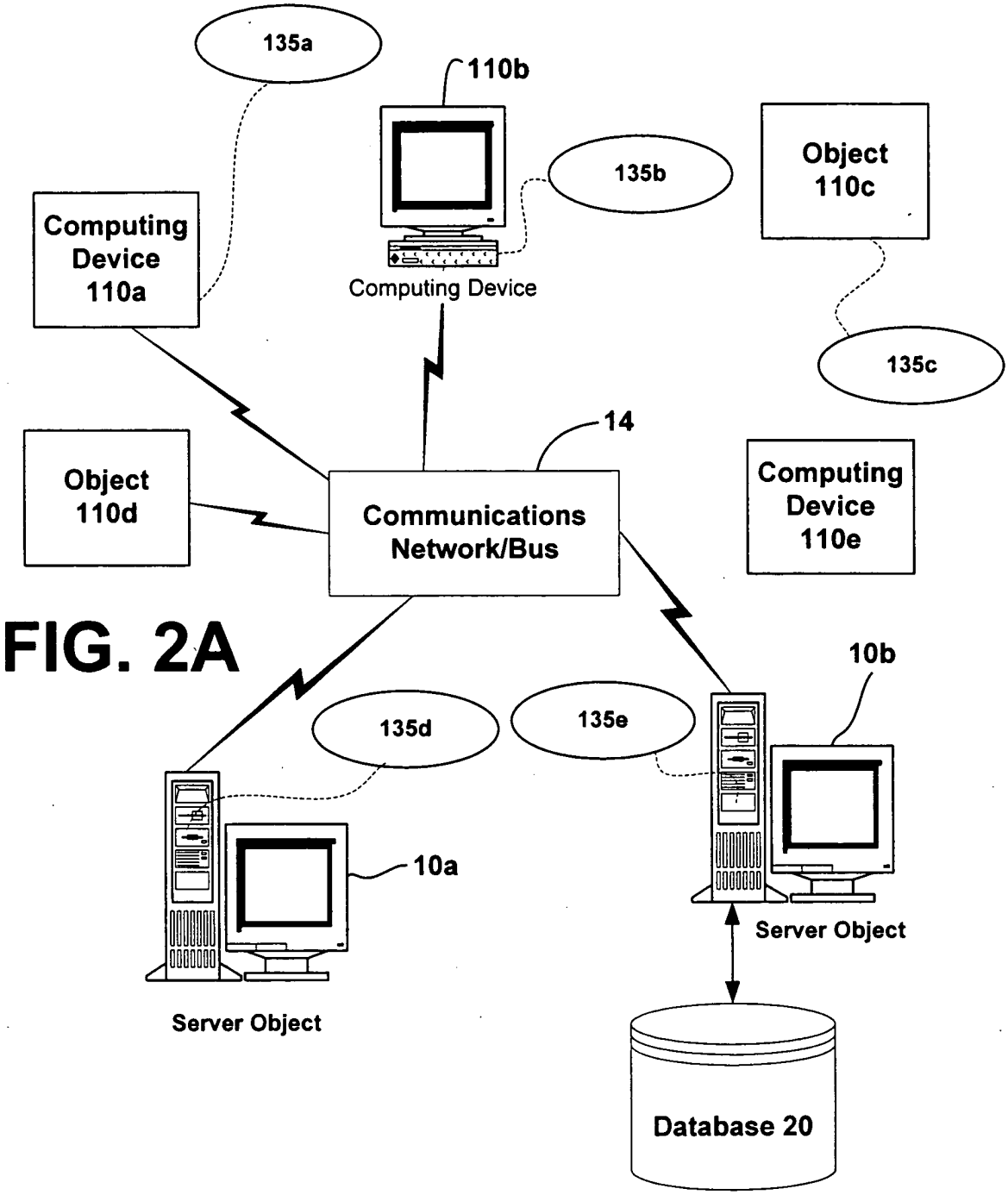

135a
110b
135b
Object
110c
Computing
Device
110a
Computing Device
135c
14
Object
110d
Communications
Network/Bus
Computing
Device
110e
10b
135d
135e
10a
Server Object
Server Object
Database 20

FIG. 2A

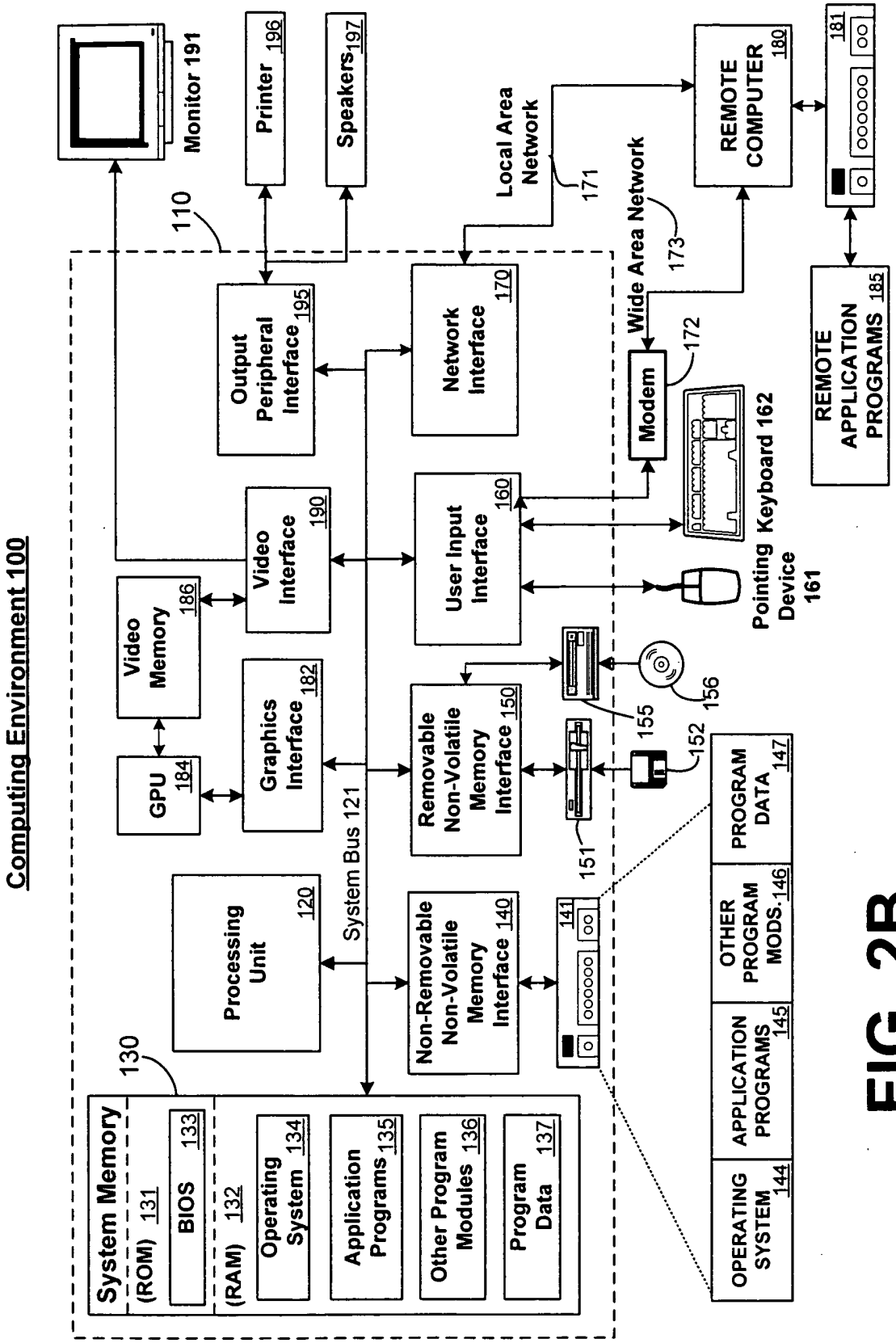

Computing Environment 100
Monitor 191
Printer 196
Speakers 197
110
Local Area Network
171
Wide Area Network
173
REMOTE COMPUTER 180
181
Output Peripheral Interface 195
Network Interface 170
Modem 172
REMOTE APPLICATION PROGRAMS 185
Video Interface 190
User Input Interface 160
Keyboard 162
Pointing Device 161
Video Memory 186
GPU 184
Graphics Interface 182
Removable Non-Volatile Memory Interface 150
155
156
152
151
System Bus 121
Processing Unit 120
Non-Removable Non-Volatile Memory Interface 140
141
130
System Memory
(ROM) 131
BIOS 133
(RAM) 132
Operating System 134
Application Programs 135
Other Program Modules 136
Program Data 137
OPERATING SYSTEM 144
APPLICATION PROGRAMS 145
OTHER PROGRAM MODS. 146
PROGRAM DATA 147

FIG. 2B

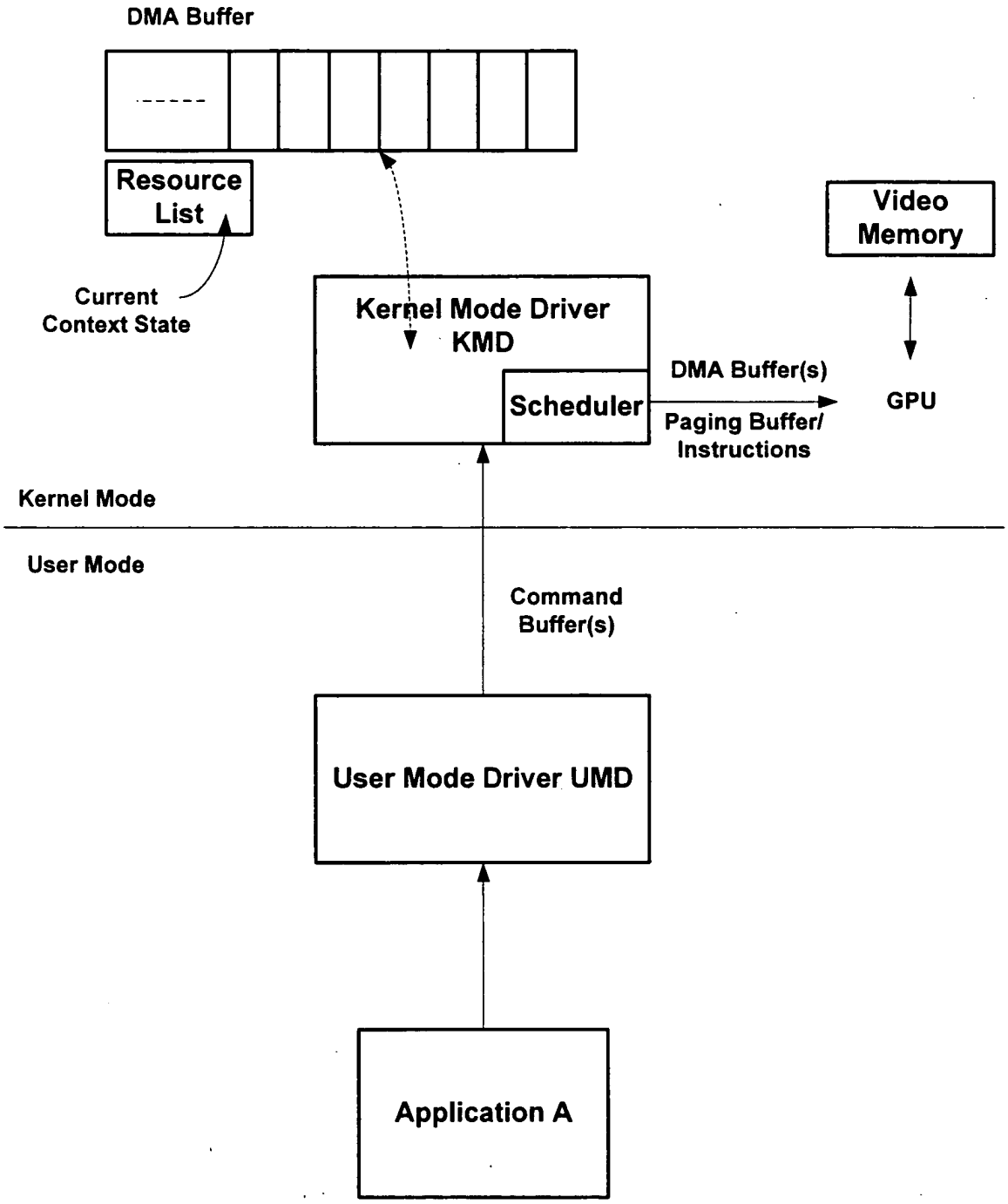

DMA Buffer
Resource List
Current Context State
Video Memory
Kernel Mode Driver KMD
Scheduler
DMA Buffer(s)
Paging Buffer/ Instructions
GPU
Kernel Mode
User Mode
Command Buffer(s)
User Mode Driver UMD
Application A

FIG. 3A

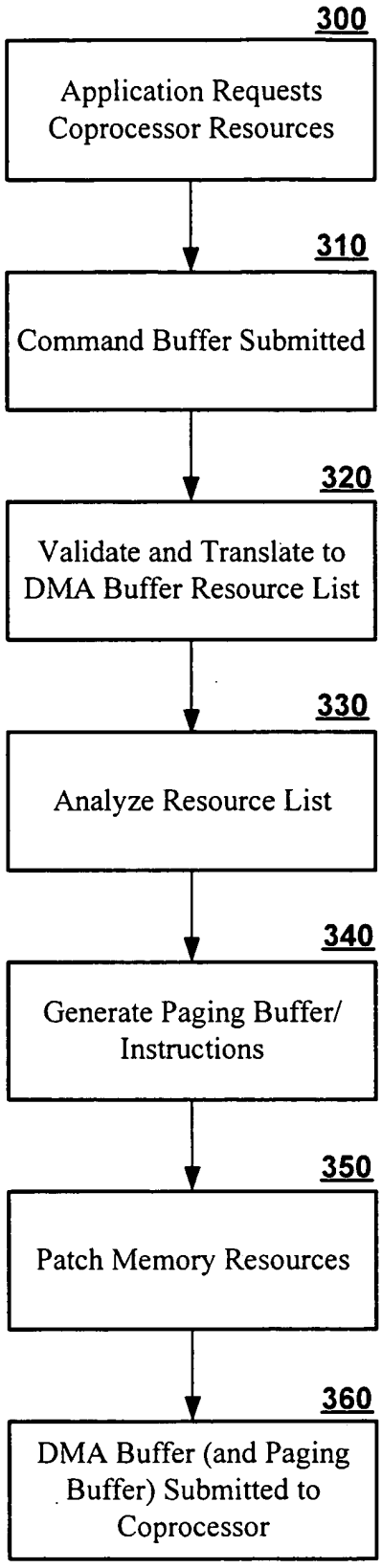

300
Application Requests Coprocessor Resources
310
Command Buffer Submitted
320
Validate and Translate to DMA Buffer Resource List
330
Analyze Resource List
340
Generate Paging Buffer/ Instructions
350
Patch Memory Resources
360
DMA Buffer (and Paging Buffer) Submitted to Coprocessor

FIG. 3B

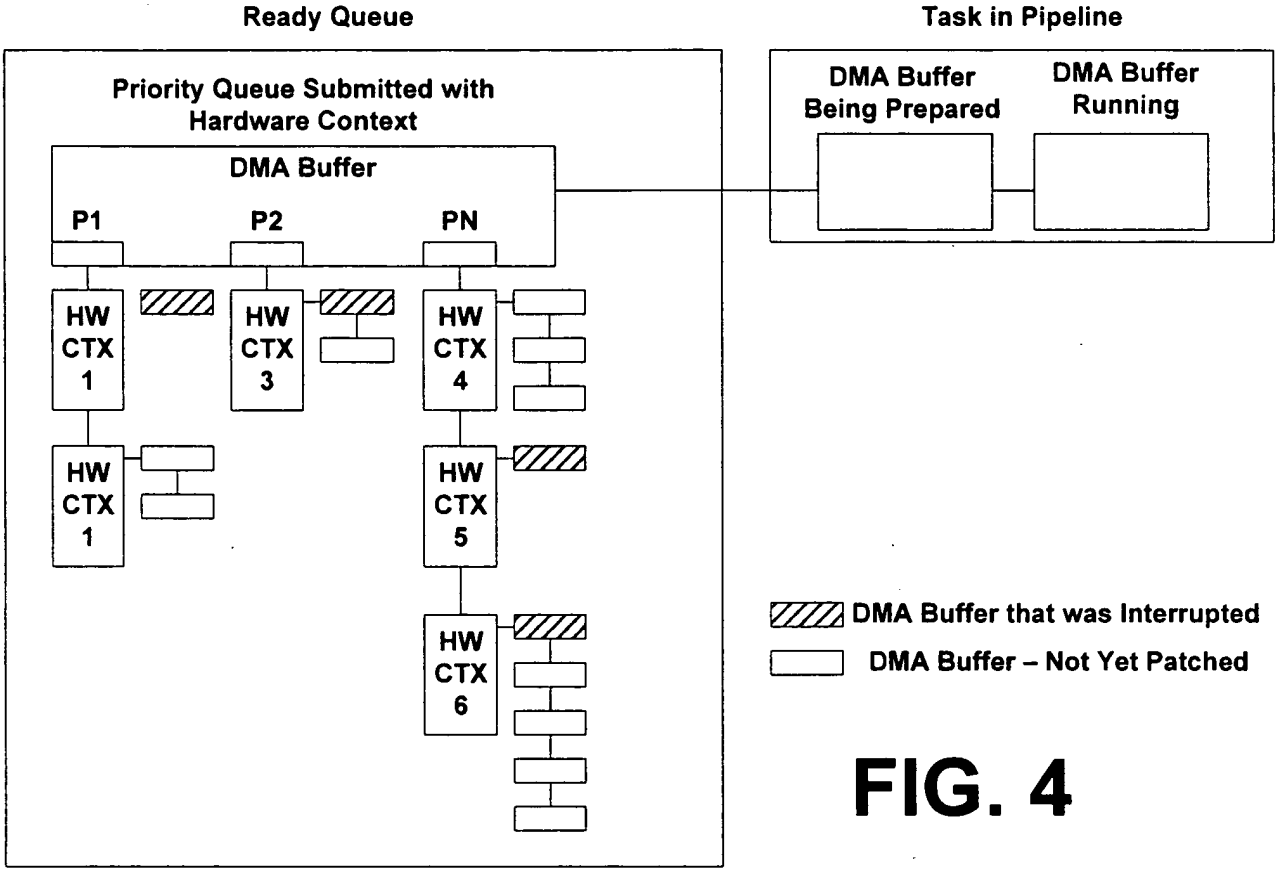

Ready Queue
Task in Pipeline
Priority Queue Submitted with Hardware Context
DMA Buffer
P1
P2
PN
HW CTX 1
HW CTX 3
HW CTX 4
HW CTX 1
HW CTX 5
HW CTX 6
DMA Buffer Being Prepared
DMA Buffer Running
DMA Buffer that was Interrupted
DMA Buffer – Not Yet Patched

FIG. 4

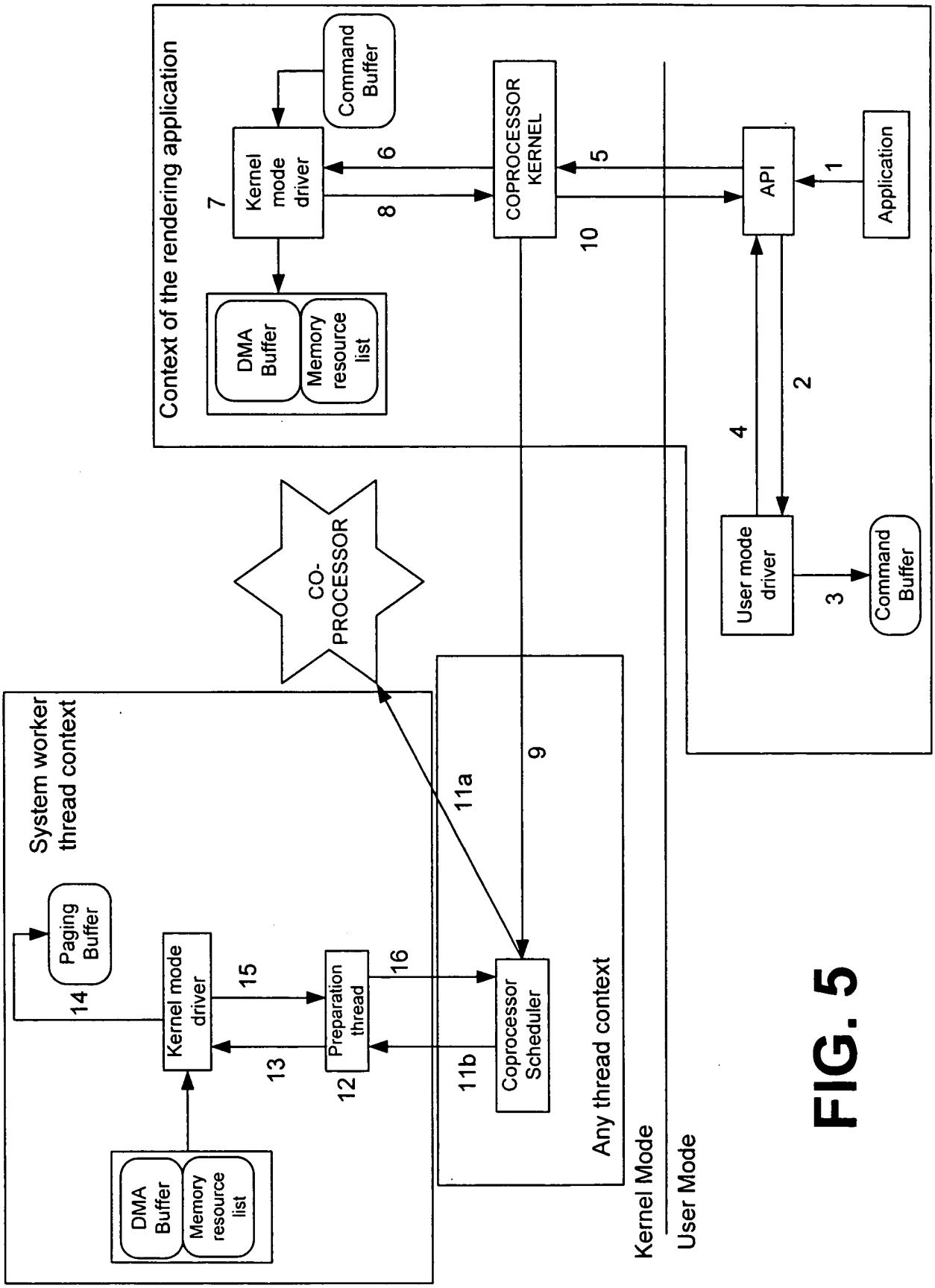
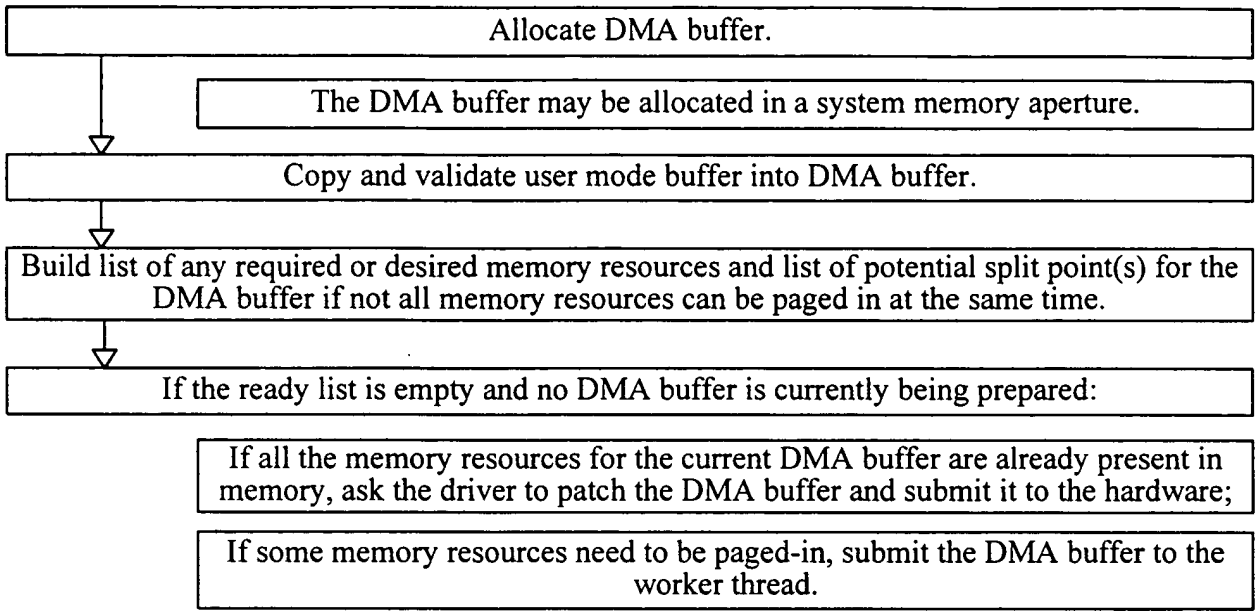

Context of the rendering application
Command Buffer
Kernel mode driver
DMA Buffer
Memory resource list
COPROCESSOR KERNEL
API
Application
User mode driver
Command Buffer
CO-PROCESSOR
System worker thread context
Paging Buffer
Kernel mode driver
Preparation thread
Coprocessor Scheduler
DMA Buffer
Memory resource list
Any thread context
Kernel Mode
User Mode
1
2
3
4
5
6
7
8
9
10
11a
11b
12
13
14
15
16

FIG. 5

Exemplary algorithm

PROCESS A: Submit (irql passive, rendering thread context)



PROCESS B: Quantum expires (irql device, any thread context)

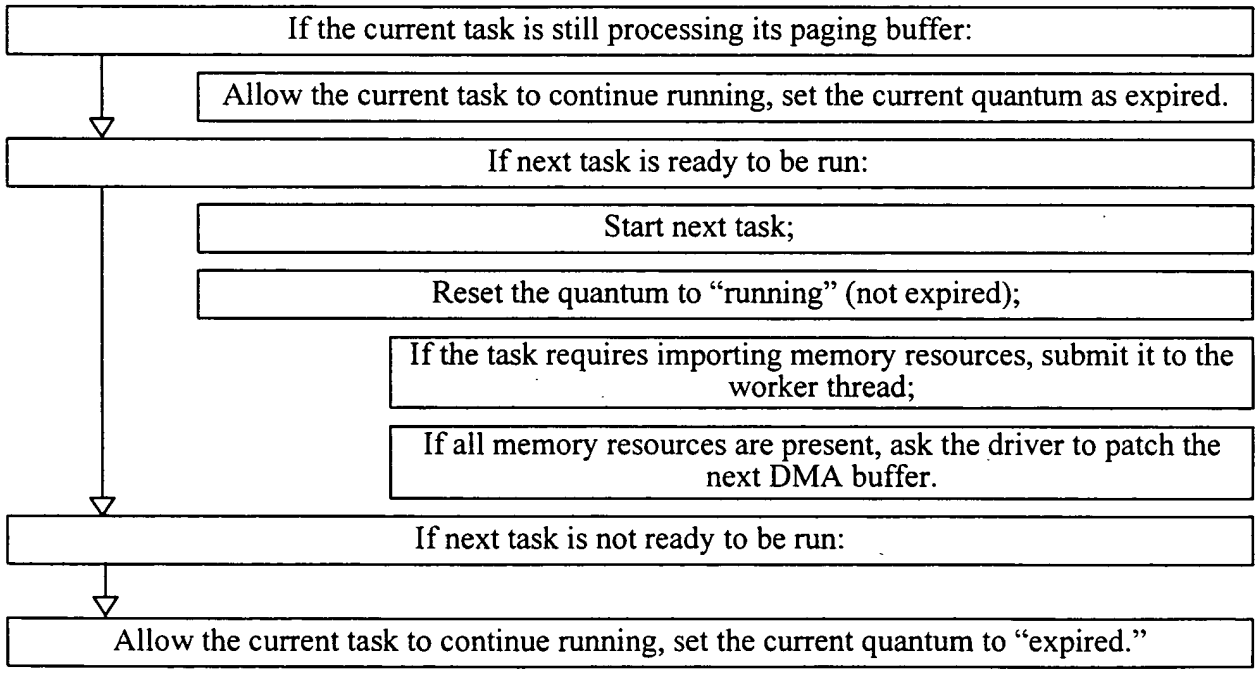


Fig. 6A

Exemplary algorithm

PROCESS C: Task finishes (irql device,, any thread context)

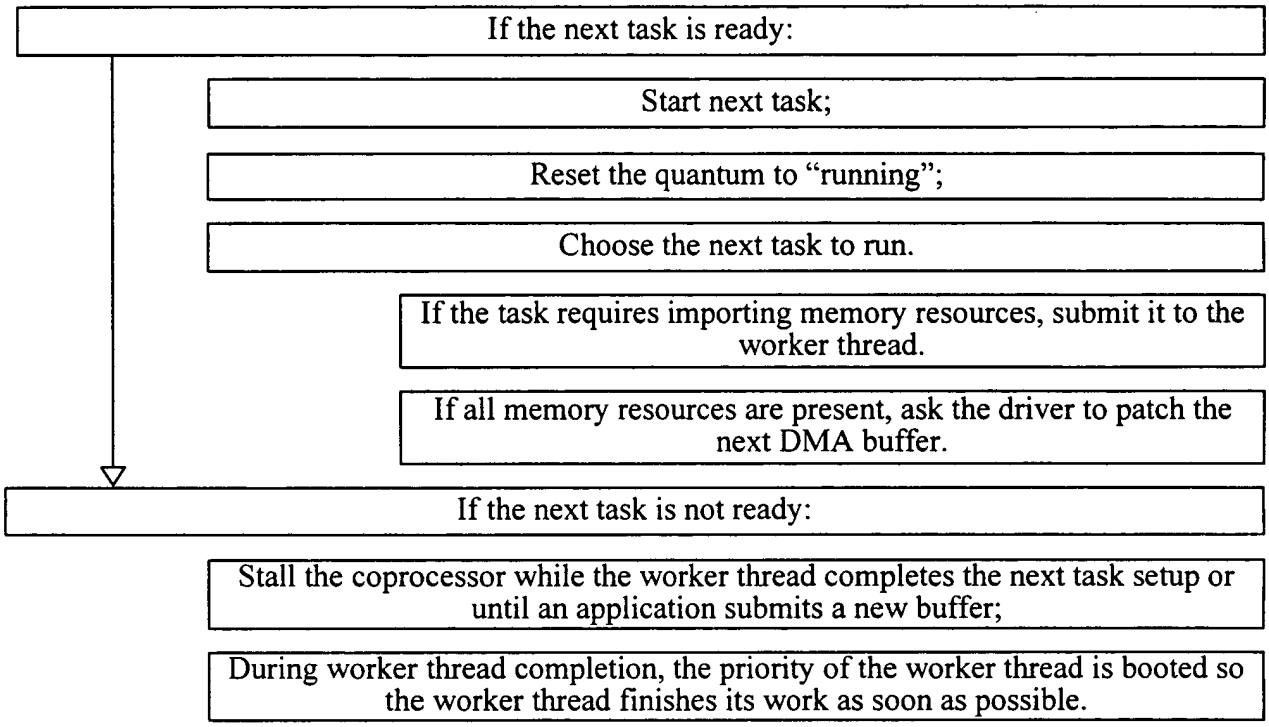


Fig. 6B

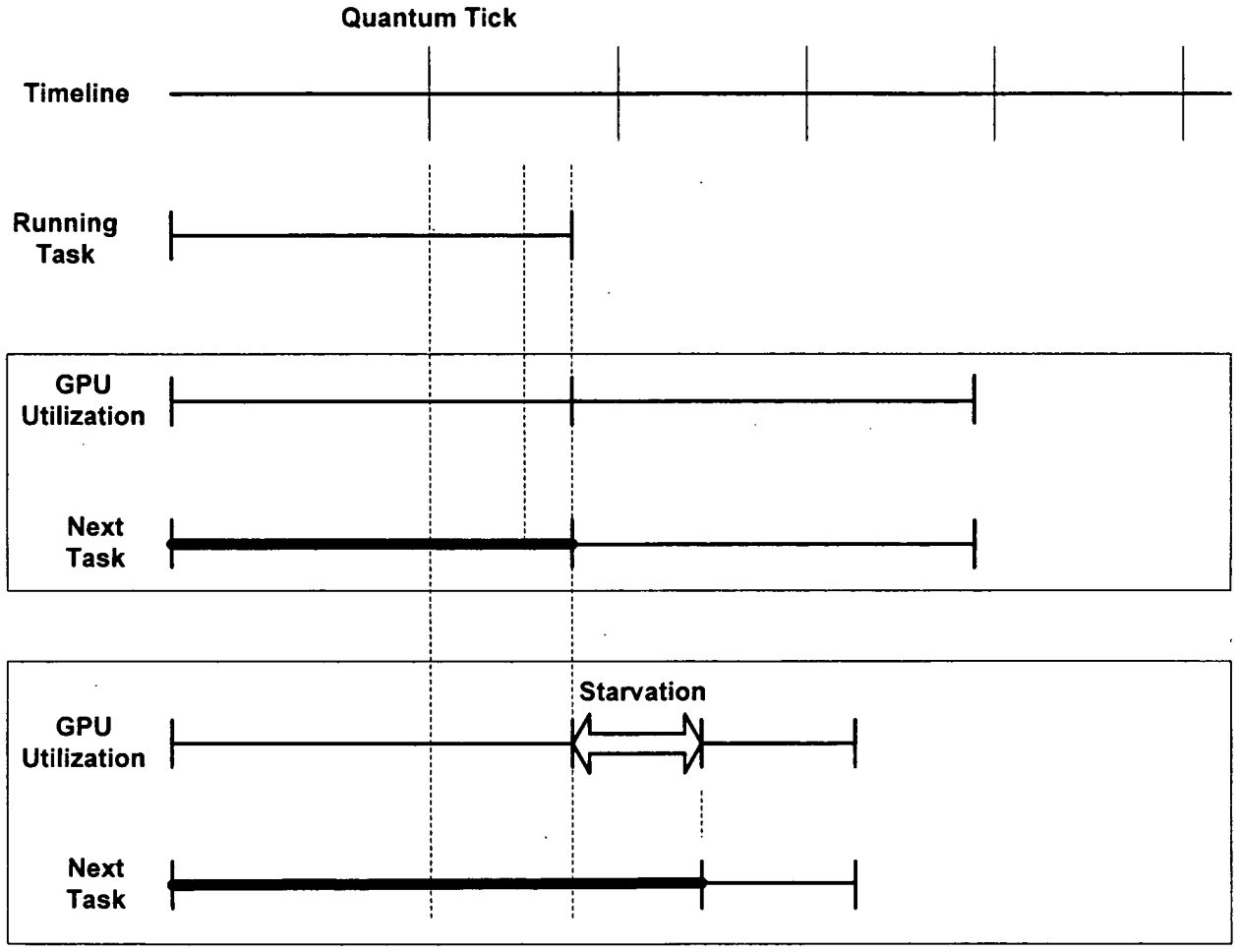
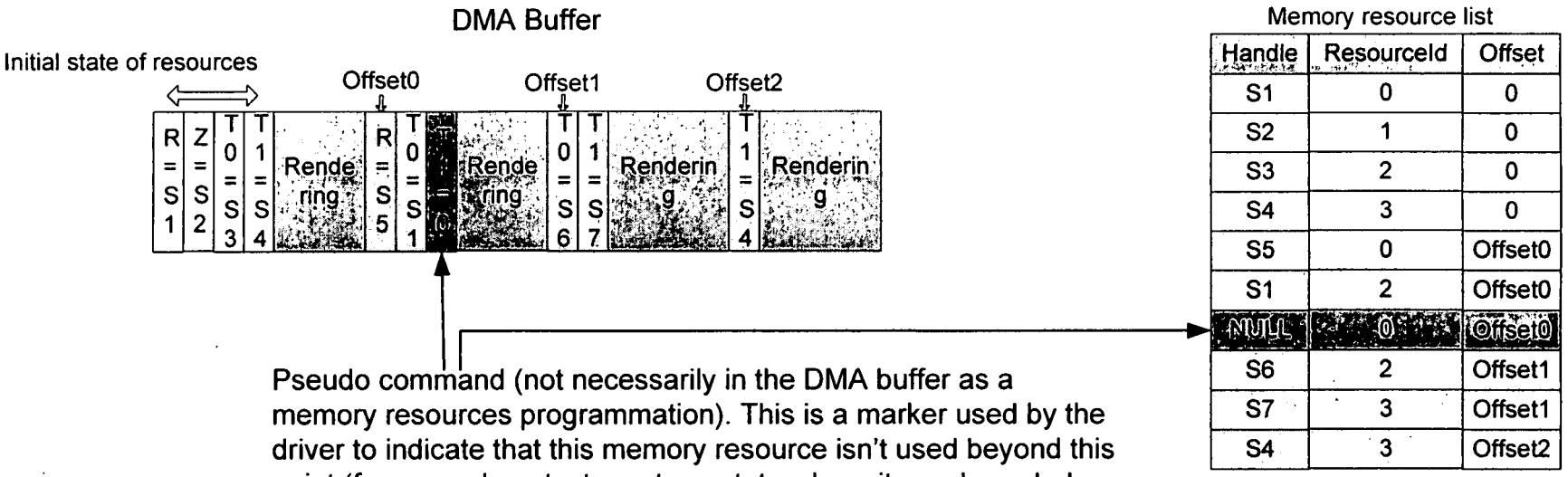
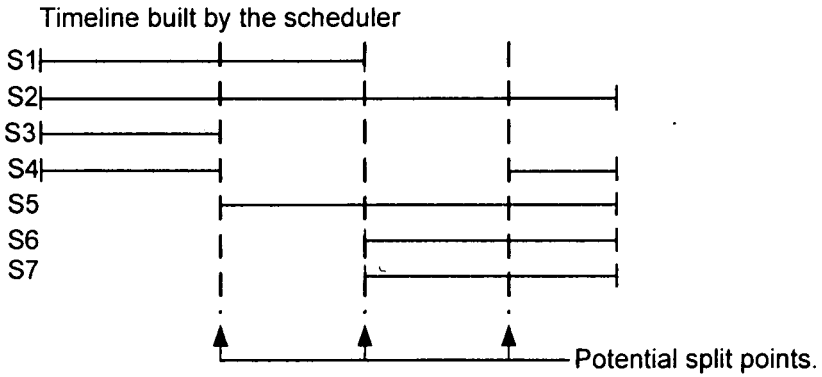

Quantum Tick
Timeline
Running Task
GPU Utilization
Next Task
Starvation
GPU Utilization
Next Task

Fig. 7



Memory resource list

Handle	ResourceId	Offset
S1	0	0
S2	1	0
S3	2	0
S4	3	0
S5	0	Offset0
S1	2	Offset0
NULL	0	Offset0
S6	2	Offset1
S7	3	Offset1
S4	3	Offset2



Legend
R = Render target
Z = Z-buffer
T0 = Texture in stage 0
T1 = Texture in stage 1
S# = Memory resources #

Fig. 8

Exemplary algorithm

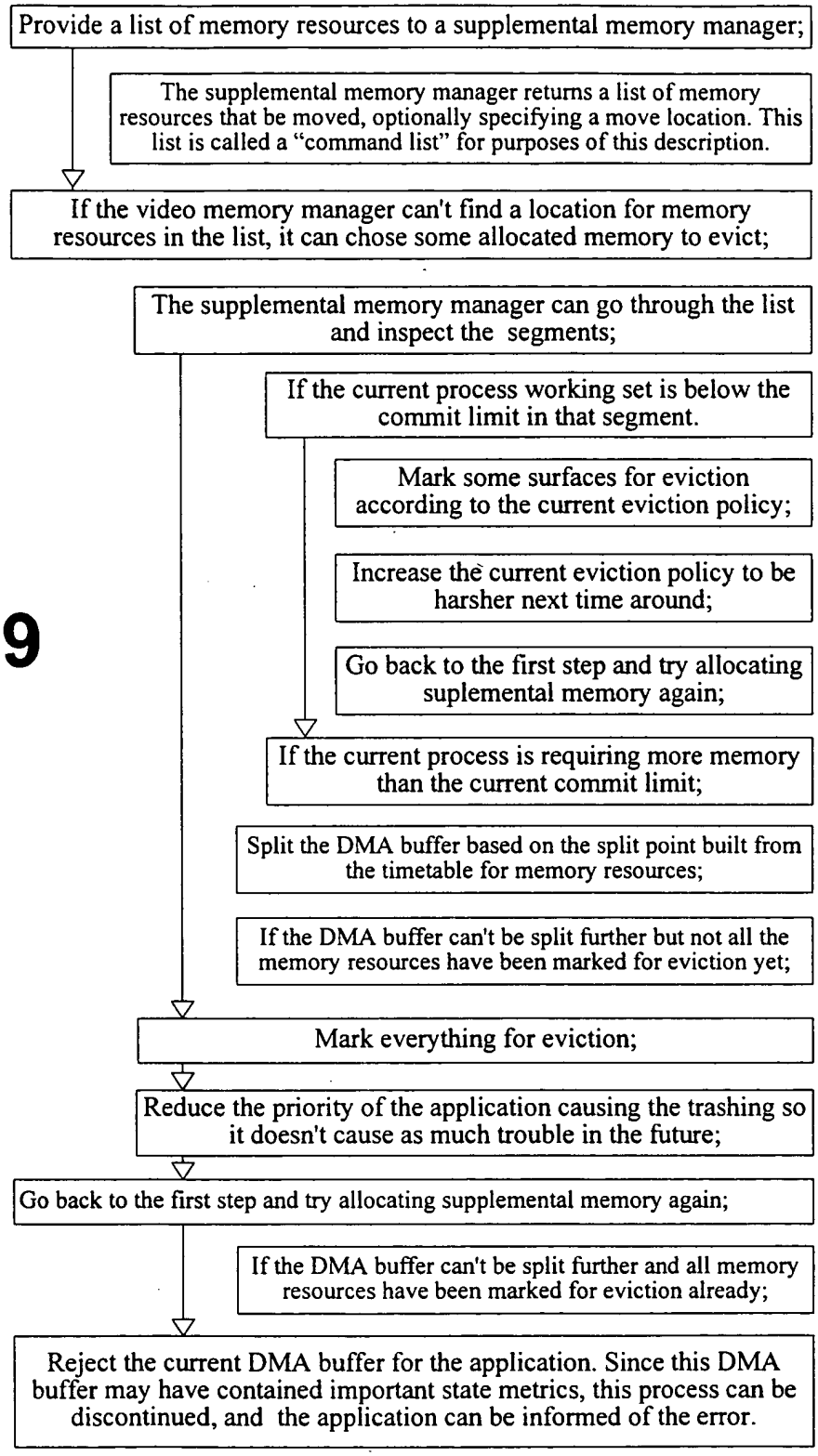


Fig. 9

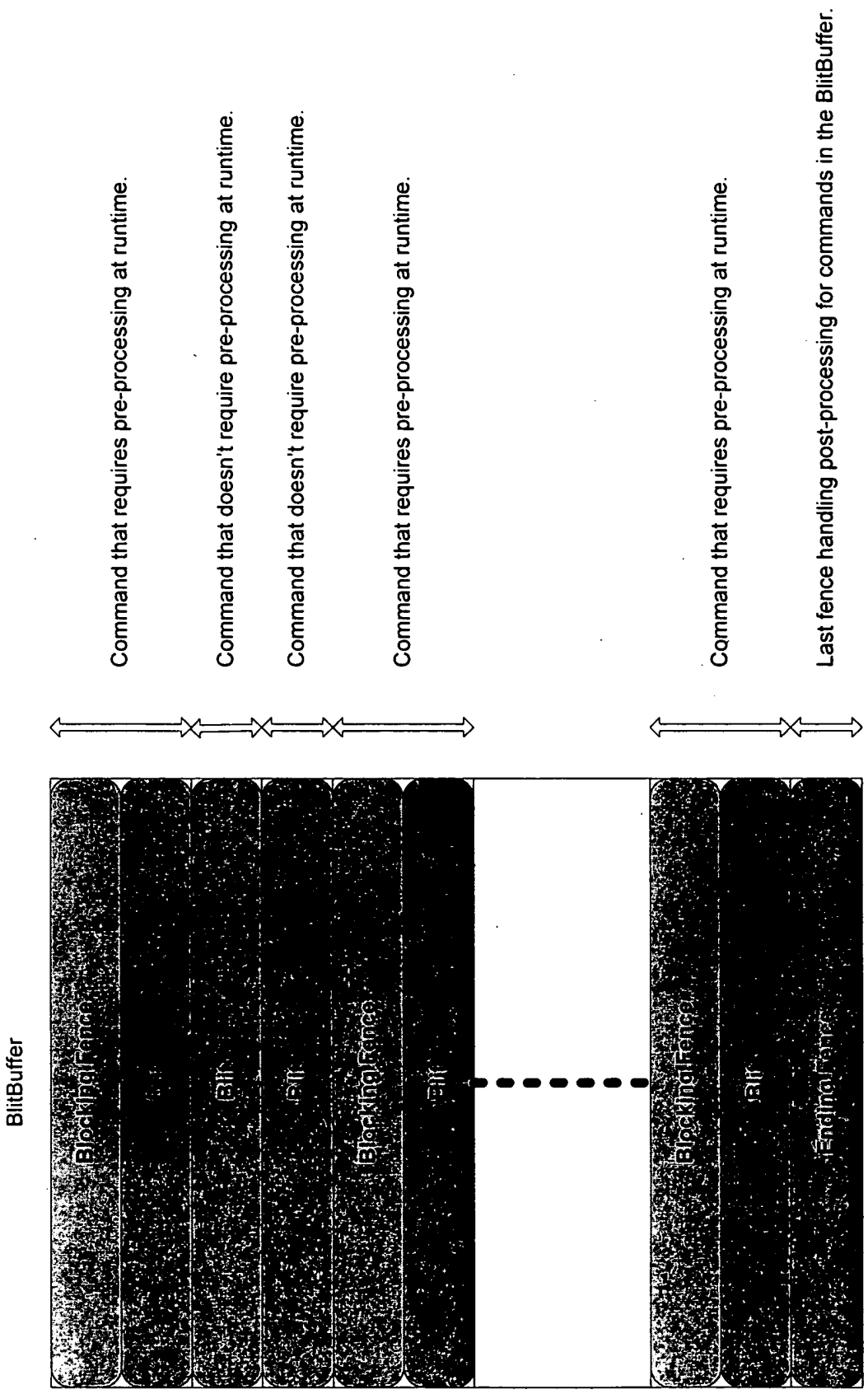

BlitBuffer
Blocking Fence
Blit
Blit
Blocking Fence
Blit
Blocking Fence
Blit
Terminal Fence
Command that requires pre-processing at runtime.
Command that doesn't require pre-processing at runtime.
Command that doesn't require pre-processing at runtime.
Command that requires pre-processing at runtime.
Command that requires pre-processing at runtime.
Last fence handling post-processing for commands in the BlitBuffer.

Fig. 10

Exemplary algorithm

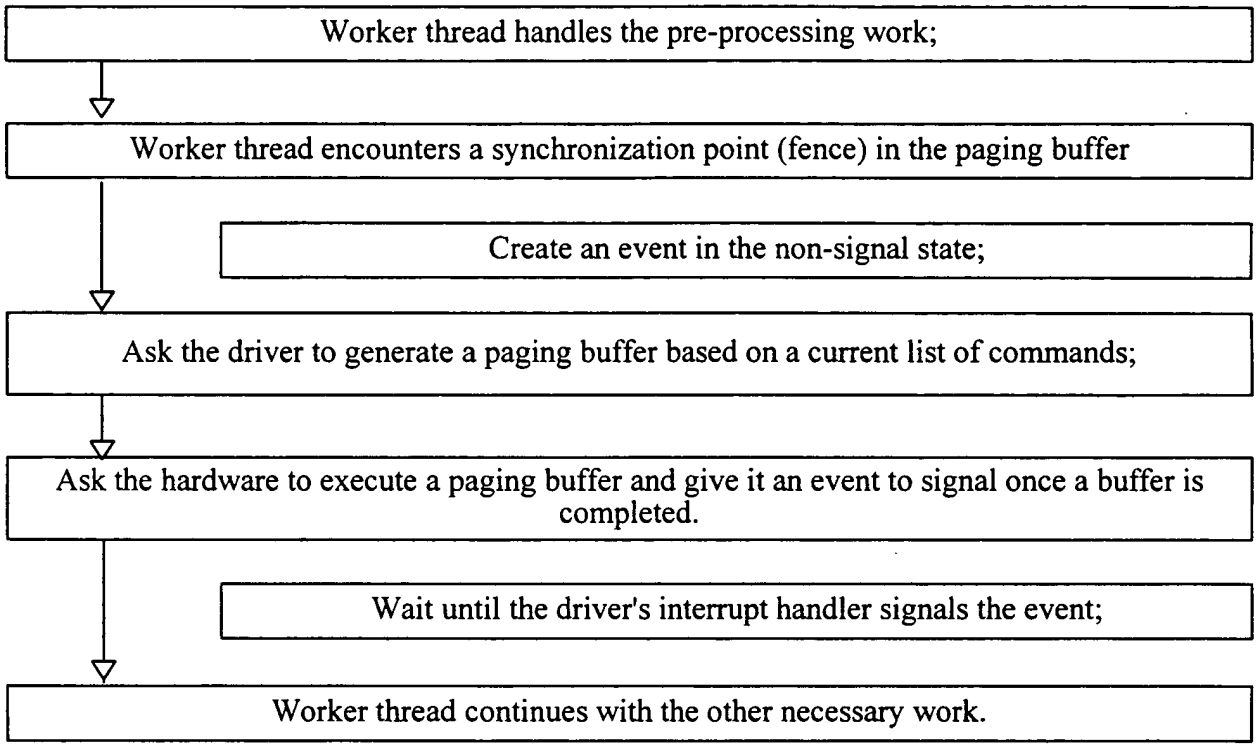


Fig. 11